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ABSTRACT

The evaluation of an interdisciplinary, process curriculum for real problem solving required a tool for differentiating that program's application from the actual treatments taken by students receiving more traditional alternatives to the experimental program. Treatments could not be controlled or assigned at random, and these restrictions underscored the need to distinguish between programs in natural settings at the level of student learning activities. An observation instrument, "System to Understand the Dynamics of Education in Non-Traditional Settings (STUDENT)," was developed which enabled reliable, practical representation of the students' behaviors in both groups. Its ease of application and analysis of results were illustrated with data contrasting student behaviors in the experimental and comparison groups for two years of data collection. The results also reflected changes in application of the experimental program over the two years. (Author)

ANALYSIS OF STUDENT BEHAVIORS IN TRADITIONAL AND NONTRADITIONAL PROGRAMS

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Paper presented at the American Educational Research Association Annual Meeting, Boston, April, 1980

Abstfact

The evaluation of an interdisciplinary, process curriculum for real problem solving required a tool for differentiating that program's application from the actual treatments taken by students receiving more traditional alternatives to the experimental program. Treatments could not be controlled or assigned at random, and these restrictions underscored the need to distinguish between programs in natural settings at the level of student learning activities. An observation instrument was developed which enabled reliable, practical representation of the students' behaviors in both groups. Its ease of application and analysis of results were illustrated with data contrasting student behaviors in the experimental and comparison groups for two years of data collection. The results also reflected changes in application of the experimental program over two years.

ANALYSIS OF STUDENT BEHAVIORS IN TRADITIONAL AND NON-TRADITIONAL PROGRAMS

During the last decade, the observation of subjects in natural settings has received considerable attention as a promising technique for data collection in educational research. In a single reference, Simon and Boyer have compiled the most comprehensive collection of observation instruments in their 17-volume anthology Mirrors for Behavior (1967, 1970a; 1970b), with documentation on 92 observation systems, 73 of which were designed for classroom observation. A computer search of the Educational Resources Information Center (ERIC) files suggests that the number of existing instruments for systematic observation of classroom instruction may well be placed in the hundreds.

Confronting the chaos which has developed, Rosenshine and Furst (1973) offered a very seasoned perspective on the maze of instrumentation and research in their incisive critique of the state of the art. With so many existing systems which are underdeveloped, underused, and underresearched, Herbert and Attridge (1975) even urged a halt to the creation of new instruments without good reasons to justify their development. Their guide for developers and users of observation systems stands out in the literature for its attention to the issue of practicality in the implementation of a system and the dissemination of its results. Yet, a system which is difficult to apply is not likely to yield valid measures, and one which requires extensive observer training or costly recording equipment is not likely to be used at all. Even under favorable circum-

stances for adoption, a system whose [redacted] cumbersome to assemble, analyze, interpret, and disseminate, is [redacted]y to be used regularly beyond the descriptive element in the research [redacted]op endorsed by Rosenshine and Furst (1973, p. 127) for improving educational practice.

The purpose of this article is to illustrate an observation system (a) whose functions apparently could not be served by prior extant systems; (b) which is relatively easy and inexpensive to apply; (c) whose data can be analyzed and interpreted readily by educational practitioners wihtout special training or equipment; and (d) whose results enable potentially insightful comparisons for teacher training or program evaluation.

The Instrument

Context for Development

The new observation instrument was developed as a means for comparing the actual instructional treatments received by a national sample of experimental classes using an experiential interdisciplinary curriculum in science and mathematics for real problem solving, and "control" classes who were pursuing their regular instruction in science and mathematics. Entitles a "System To Understand the Oynamics of Education in Non-Traditional Settings," the name of the instrument was fitted to the acronym STUOENTS to emphasize that the focus of the observation schedule is what the students do, not what the teacher does. In this regard, Charters and Jones offered an important caveat to educational evaluators who fail to certify that treatments applied in experimental and control situations differed at the level of student learning activities:

> The manifest purpose of the teacher's role performance is to produce learning in students, but this cannot happen directly. The best the teacher can do is to induce statements to engage in activities deemed instrumental to the covert psychological processes he hopes to affect. It is the student's own activities and experiences that are most immediately related to learning outcomes...and it is of no small importance for program evaluators to measure the school's educational program as experienced and enacted by students (Charters and Jones, 1972, pp. 6-7).

Determining the essence of these differences between the experimental treatment and the comparison programs was a special concern for the evaluation of Unified Science and Mathematics for Elementary Schools (USMES) because of the student-centered nature of the USMES curriculum.

The USMES project was formed in response to the recommendations of the 1967 Cambridge Conference on the Correlation of Science and Mathematics in the Schools. Funded by grants from the National Science Foundation and coordinated by a staff at the Education Development Center in Newton, Massachusetts, the USMES project has purported to develop the competencies of elementary shcool students for real, complex problem solving. The goal of the USMES project has been the development and trial implementation of approximately 30 interdisciplinary units engaging the students in long-range investigations of real and practical problems taken from their school or community environments. By responding to these problems, called "challenges," the students are supposed to develop their problem-solving abilities and to do so in a manner that gives them an experiential understanding (learning-by-doing) of the problem-solving process, as well as the acquisition of basic skills and concepts, particularly in the areas of science and mathematics. Acting only as a coordinator and collabora-

tor, the teacher is supposed to adopt a non-traditional, more indirect style of teaching. Another emphasis of the program is that progress toward a solution to a problem should require the combined efforts of a group of students, not just an individual student working alone. While some work may be done individually, the USMES approach provides for a division of labor and an exchange of ideas--a total group effort which should enhance students' socialization and cooperative spirit.

Unlike more structured curricula which might prescribe relatively uniform student and/or teacher activities through texts, workbooks, teacher guides, programmed instruction, etc., USMES is purported to be "an important new style of education," (Education Development Center, May 1974, p. 1). While a series of challenge units and tangible resource materials have been developed for USMES, this program, according to its developers, is more accurately portrayed as a philosophy of education than as a collection of materials. Each USMES challenge should evolve from the children's identification of, and action on, a problem which is real and important to them. And so, by design, the USMES approach could result in as many different treatment groups as there are classes using USMES. Furthermore, the evaluation team could assume that classes in the "control" group were homogeneous only with respect to their non-use of USMES.

Since treatments and dosages could not be assigned or manipulated by the evaluator, it was not enough to apply a pre/post control group design to assess differences in students' cognitive and affective development. Tentative explanations for any observed differences in student performance need to be studied as well.

philosophy is an eclectic one; it encompasses features of the theoretical positions expressed by Dewey, Bruner, Gagne, and others. When STUDENTS was developed, and even at this writing, the USMES developers had not articulated a theoretical position on educating students for problem solving (Shann, 1976). However, most consistently evident in the USMES developers' written statements about the USMES approach were references which called to mind John Dewey's "five logically distinct steps" of the problem solving process, his philosophy of experimentalism, and Bruner's (1960) conceptions of discovery and enquiry. These sources provided a starting point for the development of STUDENTS categories. The form underwent successive revisions and pilot testing over a period of three years in both USMES and non-USMES classes.

To the best of the evaluator's knowledge, no other observation instrument could satisfy the considerations served by STUDENTS; it could be used easily and inexpensively by trained observers to monitor students' verbal behaviors and non-verbal activities in both traditional and non-traditional student-centered classes at the elementary level. Despite the intended use of the instrument in problem solving curricula and in more traditional science and mathematics programs at the elementary level, STUDENTS has also been used effectively to contrast student learning activities during English instruction in public alternative high schools versus traditional comprehensive high schools in Massachusetts (McNeil, 1977). However, researchers who wish to investigate teacher behaviors more directly and/or to study situations in which verbal behavior is expected to predominate should find other observation instruments more sensitive to their purposes.

Several kinds of data were collected in an effort to differentiate the nature and intensity of treatments applied in the experimental and control groups (see Shann, 1975). Widely varied patterns of USMES use were reported by USMES teachers. Furthermore, the distribution of average times reportedly spent on non-USMES school subjects and activities for USMES classes when they did not pursue USMES were very similar to the distribution of average times reported for control classes, and for both groups, the measures of variance in these times were very large. Similarly, both USMES and control groups represented tremendously variable patterns in the kinds of non-USMES curriculum materials and programs they used. Indeed, there was as much variability within groups as there was between treatments, except for the fact that control classes had not used USMES. Only the STUDENTS observation instrument was sensitive enough to abstract clearly distinguishable differences in the kinds of activities pursued by USMES students working on USMES challenges versus control students pursuing their regular science/mathematics instruction.

Identifying Characteristics

As its title suggests, STUDENTS was designed to monitor the learning activities of students in a non-traditional educational program. Yet to enable comparisons between treatment groups for the USMES evaluation, the instrument had to afford opportunities to tally evidence of teacher directiveness and to represent what students were doing in supposedly more traditional alternative programs.

Both theoretical and practical considerations guided the selection of categories of behaviors to include in the instrument. The USMES

The final version of the STUDENTS form includes 29 categories of behaviors grouped in four areas: (a) nonverbal, physical activities of the child; (b) verbal interactions of the child--with other children, with the teacher, and with the class as a whole; (c) more passive look/listen behaviors of the child; and (d) other behaviors, such as maintenance, waiting, and fooling around. In Table 1, the 29 behaviors are listed as they appear on the form used for data collection, and in Table 2, the behavioral categories are described with examples provided.

Insert Tables 1 and 2 about here

Use of STUDENTS

Observers must be trained in the proper use of this observation instrument. Upon entering the classroom for the instructional period of interest, the observer conducts seven rounds of observation. During each round, the observer is to look at each child as if taking a snapshot, then place a tally for each child in the behavior category on the form which best describes what that child was just doing. Thus, the number of tallies on each round should equal the number of students in the class. Each round of observations could take anywhere from a few seconds, if all the children are engaged in the same activity, to a maximum of five minutes. However, to attain more uniform time samplings across classes and occasions of observation, the time period between the start of each round is set at five minutes.

Persons of professional, congenial, non-threatening demeanor should be selected as observers, and the same person should be assigned

for repeated observations in sample classrooms so as to minimize the disruptive or threatening effects on students and teacher which an unfamiliar person can have on a classroom. Prior to training, observers should study the category descriptions and examples, and the investigator/training director should pilot test the form to determine if the categories of behaviors are representative and exhaustive of the behaviors to be observed in thei study. The STUDENTS form might be modified by the deletion of categories or examples of behaviors not likely to be observed in the new situations, or by the inclusion of new examples of behaviors more likely to be witnessed. Category 10, "Reads 'How-to' cards," which was appropriate for the USMES evaluation, might be deleted or changed to "Consults reference material" such as a library book, encyclopedia, dictionary, etc., to locate information or find out how to do something, rather than ask the teacher.

Videotapes of classes thought to be representative of those which will be observed in the study should be obtained for observer training. As a group, observers should practice using the form (see Table 1) to record the behaviors they witness on the tapes. The training director should rerun segments of the tapes so that observers can compare tallies for the same behaviors and resolve any discrepanciees in their choices of categories. Once the observers can designate with ease and precision the categories for the behaviors they witness, they should practice applying the five-minute rounds of observations with actual classes similar to those which will be used in the study. Ideally, this practice should take place with all the required observers viewing a class through mirrored

glass. If this situation is not available for training, the observers should practice in real classes, as unobtrusively as possible, in groups of two's so that they can check the agreement of their tallies, by tally, not just total tallies. Particularly when the observation data will be used to compare programs, the observers should be directed to arrange comparable time slots within the day and within the week for observing the classes undergoing different treatments.

Reliability and Validity

The provisions and suggestions for training in the use of STUDENTS were made in consideration of the reliability and validity of the data. Perfect intra- and inter-scorer reliability has been obtained during the training sessions with the STUDENTS form for the 1974-75 USMES data collection. The time sampling achieved in the use of seven five-minute rounds of observation in each instructional period should enhance the reliability of the measures as far as their stability is concerned.

The time sampling procedure also addresses the issue of validity of the data. The tallies should reflect the distribution in amounts of time students devoted to each activity. More importantly, the behavior categories as included or modified in the form should represent the kinds of behaviors typically found in the classes to be studied. This assurance should be achieved through pilot testing of the form as suggested earlier, and through content validation of the form by knowledgeable judges. Other validity evidence that this observation system revealed student behavior patterns which could explain student effects of the USMES curriculum was offered in the USMES evaluation reports (Shann, 1975; Shann, et al, 1975).

Analysis of the Data

The number of times each class should be observed, the number of classes to be observed, the number of comparison groups to be represented -- these and other considerations are issues for the design of a particular study and the purpose of that particular investigation. In general, however, the analysis of data from STUDENTS requires only the averaging of tallies across rounds for each class or group of classes and the expression of these average frequencies as percentages of total frequencies. The percentage of tallies recorded in each behavior category offer, then, an indication of the amount of time students devoted to that behavior category. Even the unaltered raw data from a single recording form may be instructive to investigators who wish to examine any changing patterns in student behaviors within a 35-minute time frame for a single class, and more sophisticated analyses of the data from students can be accomplished, too, with relative ease.

Illustration of Results

Results from the 1973-74 and 1974-75 school years of data collection for the USMES evaluation have been selected to illustrate the application of STUDENTS. For each year of data collection, the sample classes were chosen to include a cross section of elementary grade levels, geographic areas, and socio-economic levels. For the 1973-74 data shown, all USMES classes were taught by teachers newly trained in USMES at national workshops, while their controls for 1973-74 were classes from the same school, at the same grade level, whose teachers had not been trained to

use USMES. The 1974-75 data were based on classes of students new to USMES whose teachers included a cross section of new and experienced USMES teachers. Controls for the 1974-75 sample were matched with the USMES classes for grade level, socioeconomic level, geographic area, and general features of the school program, but this year the controls were obtained from neighboring schools where no USMES was used.

Observers were directed to apply the STUDENTS observation technique during the Fall, Winter, and Spring of the 1973-74 school year, with the specific dates to be worked out by the individual observers and their participating teachers. Observers were told to arrange specific dates for the 1974-75 classroom observation schedule which would sample USMES class time at the beginning, middle, and end of the units, however long they were expected to last, so that observation times in each USMES class were dependent on the duration of the unit. Both years, the observers were directed to arrange comparable time slots within a day and within a week for observing each USMES class and its corresponding control. USMES classes were to be observed while USMES was going on; control classes were to be observed during their mathematics or science class periods.

The evaluators had expected that the seasonal distribution of Fall, Winter, and Spring observations during 1973-74 would correspond roughly to the beginning, middle and end of USMES units, but this was not the case. Many classes completed their units in less than a year's time, and the USMES project developers no longer urge that the duration of a unit be one school year. The variable lengths of time which the sample classes devoted to USMES account in part for the attrition observed in the "n's".

Insert Tables 3 and 4 about here

The figures shown in the cells of Tables 3 and 4 represent estimates of the percentages of time spent on each category of behavior by USMES and control groups, at points near the beginning, middle, and end of USMES unit activity by USMES classes.

Interpretation

It was hypothesized that in the USMES mode of learning, the teacher would have to adopt the role of coordinator or collaborator, rather than the director's role more typically adopted by classroom teachers. Students using USMES were expected to engage in active, hands-on, "learning by doing" as they pursued problem solving activities, working cooperatively with their peers and relying less on their teachers for information and direction. By comparison, children in control classes were expected to exhibit more passive, structured, teacher-directed and teacher-dominated behaviors. The STUDENTS observation data in Tables 3 and 4 offer some support for these hypotheses, but traditional teacher practices were still evident in USMES classes.

Teachers continued to dominate class activities. In both USMES and control classes for both years of data collection, students spent the largest percentages of class time listening to and/or looking at the teacher. However, different patterns of teacher domination in USMES classes emerged for 1973-74 versus 1974-75. In 1973-74, there were seasonal

differences in the amounts of teacher-dominated student activity in USMES classes, as control classes exhibited a sustained focus on the teacher (see Table 3, line 26). Control students spent fully 31% of their observed class time in the Fall listening to or looking at the teacher, while USMES students spent a much smaller percentage of their time (14%) in this way. The differences dropped from a ratio of 2:1 in the Fall (31% control versus 14% USMES), to a ratio of 3:2 in the Winter (30% versus 21%), to almost a 1:1 ratio in the Spring, with no appreciable difference between USEMS and control classes (28% versus 26%). These results suggested that in the beginning the 1973-74 USMES teachers did in fact adopt less dominating roles. However, in the final stages of the units, the USMES teachers dominated class time to a much greater extent than they did earlier in the school year, perhaps because they were addressing original student reports of what was learned in the units (see Table 3, line 19).

Results from the 1974-75 data collection showed sustained emphasis of 16% to 20% of observed class time on listening to and/or looking at the teacher--for both USMES and control classes. The teacher interview data also obtained as part of the USMES evaluation, suggested an explanation for this curious finding. Many teachers reported that their instructors at Summer 1973 USMES workshops had urged them to refrain almost totally from directing their students' work on USMES. This report may not have been factual, and indeed the developers acknowledged the importance of some teacher direction with USMES. Nevertheless, those teachers' perceptions were real. Owing perhaps to the USMES developers' efforts to address understandings about appropriate amounts of teacher directiveness in

USMES or to the experienced teacher's adaptation of the USMES program, the 1974-75 sample USMES teachers expressed more and more confidence about the importance of teacher direction at certain critical points in their USMES units for more efficient student solution of USMES challenges. Increased teacher directiveness in the USMES sample for 1974-75 may explain another year-to-year difference in the patterns of USMES student behaviors: in the 1973-74 data, the expected shifts were found in the student activities emphasized over the course of their units, but in the 1974-75 data, little variation could be seen in the patterns of student activities from one observation to another.

The data from Table 3 suggests that during the Fall, 1973 observation period, when USMES students beginning their units focused on their teachers to a relatively small extent, the USMES students were engaged in the "hands-on" activities related to preparation for, and engagement in, the data collection process for problem solving. Approximately 31% of the observed class time was directed toward constructing, assembling, and testing/experimenting (summing lines 3, 4, and 5). Calculating and recording data consumed another 14% of their time (lines 6 and 7). However, the percentages of time spent on these data collection and data management activities by USMES classes tended to diminish considerably from Fall to Winter and from Winter to Spring, 1973-74. During the Winter period, these USMES students appeared to be spending significant amounts of time taking part in class discussions or presentations (17% from line 22) and listening to/looking at their peers (13% from line 23). In the Spring, there seemed to be greater diversification of USMES student activities

across several categories, but overall attention to the teacher predominated.

Even though the 1974-75 sample USMES teachers dominated more class time than expected (see Table 4, line 25), for the balance of the time their USMES students engaged in more active, creative, and self-directed behaviors than their controls. During the first and second 1974-75 observation periods, USMES students more often pursued composition writing or illustrating (line 8). Throughout the three periods, USMES students engaged more frequently in talking to one another individually about task-related matters (line 13), in taking part in small group discussions about task-related matters (line 15) and in giving original information to the teacher (line 18).

The most striking contrast between USMES and control students involved the latter group's sustained emphasis on structured, prescriptive activities in their mathematics and science classes for both years of data collection with STUDENTS. During 1973-74, control classes spent significantly larger amounts of time in calculating (Table 3, line 6) and in pre-structured writing (line 9), probably for textbook exercises, teacher-made worksheets, or in workbooks. These two activities consumed 17% of their observed class time during the first 1973-74 observation period, 17% during the second, and 19% during the third. The corresponding percentages for the 1973-74 sample USMES classes were 9%, 2% and 1%. From Table 4, comparable figures for 1974-75 control classes (summing lines 6 and 9) were 29%, 24% and 24%; for USMES classes they were 5%, 3%, and 6%.

More extensive discussion of the differences in student behavior patterns between USMES and control groups has been offered in the USMES evaluation reports. Most salient to the present paper is the fact that the STUDENTS observation system was capable of illuminating important differences in the nature of the treatments which were actually applied to the experimental and control groups in field settings. Teacher questionnaires, program monitoring forms, and class information forms used in the USMES evaluation had revealed great variety in the nature and intensity of the uncontrolled, self-selected treatments which the groups received. Assignments could not be controlled by the evaluator. Only from the STUDENTS observation data could one abstract meaningful differences in the kinds of activities actually pursued by USMES versus control students.

Increasingly, educational practitioners have voiced a need for evaluation procedures which can be applied easily and inexpensively in natural classroom settings with minimal disruption to the instructional process. The observation procedure called STUDENTS has been offered as an instrument of data collection which meets these practical considerations, and yet is sensitive enough to compare a student-centered, process-oriented curriculum with its more traditional alternatives, encouraging more sensitive research into relationships between student learning activities and student performance.

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Recording Form for STUDENTS to Tally Seven 5-minute Rounds of Observation

Teacher _____ Date _____ Observer _____

School _____ # Students _____ USMES/Control _____ Unit/Subject _____

			1	2	3	4	5	6	7
ACTIVITIES		Measures							
		Counts							
		Constructs							
		Assembles							
		Tests/Experiments							
		Calculates							
		Records data							
		Writes composition/illustrates							
		Writes (pre-structured)							
		Reads How-to Cards; Plays Tapes							
		Reads - task							
		Free reading, writing, drawing							
		Messes around with materials							
INTERACTIONS	CHILDREN	Talks to another - task							
		Talks to another - social							
		Takes part in small group discussion - task							
		Takes part in small group discussion - social							
	TEACHER	Gives pre-structured info to teacher							
		Gives original info to teachers - task							
		Seeks information from teacher							
		Talks to teacher - social							
		Takes part in class discussion or presentation							
LISTEN/LOOK		Listen/look at child							
		Listen/look at small groups							
		Listen/look at class							
		Listen/look at teacher/lecture/film							
		Collecting materials/maintenance							
		Resting/waiting/fooling around							

Table 2

Descriptions and Examples of STUDENTS Behavior Categories

Behavior Category	Description and Examples
	Activities
MEASURES:	An instrument is used to measure distance, weight, volume or time. A measurement is read from a continuous scale.
Examples:	Timing with a stopwatch. Measuring a borad with a yard stick. Measuring the length of a sidewalk with string. Weighing a person on a scale. Measuring ounces of a soft drink in a measuring cup. Measuring amounts with measuring spoons. Measuring length with a trundle wheel. Using a tape measure to measure a person's height. Using a classroom clock for timing. Using an eggtimer. Measruing weather conditions with a barometer, thermometer or rain gauge.
COUNTS:	Quantities or frequencies are counted.
Examples:	Counting the number of pieces of metal which can be picked up by a magnet. Counting the number of people going through the lunch line. Counting the number of white Cuisenaire Rods which equal an orange rod. Counting the number of cars driving through an intersection. Counting the number of squares on a piece of graph paper. Counting the number of times a pencil can be sharpened. Counting the number of persons with a particular eye color. Counting the number of children with freckles. Counting the freckles! Counting beans, scissors or books. Counting 2's, 5's, or 10's.
CONSTRUCTS:	Physical components are put together to create a whole. Something is built or made from scratch.
Examples:	A chair is built. A soft drink is mixed. A mustery box is made. A mobile is made. An irrigation system is made. Ingredients are mixed.

CONSTRUCTS: (cont.)

Sandals are mixed.
Something is hammered together.
An apron is sewed together.
Life-size puppets are made.
Wood is cut.
Cement is mixed.

ASSEMBLES: Pre-cut or manufactured materials are assembled. A plan, set of instructions or recipe is followed.

Examples:

A plastic model airplane is assembled.
A geometric form is made from pre-cut paper shapes.
A light switch is made from electrical components.
A barometer is made from a science kit.
Stamps are glued into a stamp album.
A jigsaw puzzle is put together.
Bones are put together.
A circuit is assembled according to a plan.

TESTS/EXPERIMENTS: An experiment is performed and data is collected.

Examples:

Water is tested with litmus paper.
A soft drink is tested for taste appeal.
A circuit is tested to see if a light will turn on.
A chair is tested to see if it is the right size.
Paper towels are pulled to test strength.
A blindfold taste test is run.
Rocks are scratched to determine hardness.
A culture mold is grown on wet bread.
A bottle of pop is shaken to see if it fizzes.
Items are dropped in water to see if they float.

CALCULATES: Arithmetic is done (addition, subtraction, multiplication and division). Include math done in math workbooks.

Examples:

Sums are added.
Division is done on a Want calculator.
Frequencies are totaled.
Yards are converted to feet.
Multiplication problems are done.

RECORDS DATA: A record is made of raw data.

Examples:

The number of people crossing an intersection is recorded.
A tape recording is made of noise in a lunchroom.

RECORDS DATA: (cont.)

Pictures are taken of all the different animals for a report on the zoo.
A record is made of the number of times a die turns up three.
The height of a person is recorded.
A map is drawn of an intersection.
A record is kept of weather information.
Suggestions are written on the blackboard.
An inventory is made.
A description of an experiment is recorded.
Physical characteristics are tallied.

WRITES COMPOSITION/ILLUSTRATES: An original composition or illustration is created in connection with school work or a class assignment. (Includes graphing when the graph summarizes and illustrates findings.)

Examples:

A story is written.
A picture is painted.
A book report is written.
A graph is drawn.
A play is written.
Future field trips are mapped.
Self-portraits are drawn.
Letters are written in connection with the class project.
Social studies reports are written.
Advertisements are written.
Essay tests are taken.
Captain Cook's voyage is plotted on a map.
A histogram is drawn.

WRITES (PRE-STRUCTURED): Writting is done in workbooks or on worksheets. Pre-structured questions are answered in writing.

Examples:

Blanks in a reading workbook are filled.
A worksheet is completed.
A poem is copied.
Spelling words are written from dictation.
A questionnaire is filled out.
References are copied.
Word definitions are copied.
A true-false test is taken.
A map is traced.

READS HOW-TO CARDS AND PLAYS HOW-TO TAPES: USMES How-To cards and/or tapes are used.

READS - TASK: Reading is done in connection with school work or a class assignment.

Examples:

A reference book is consulted.
A text book is read.
A table of weights and measures is read.
A magazine is read.
Instructions are read.
A newspaper is read for weather forecast and "current events."

FREE READING, WRITING, DRAWING: Free time is used for reading, writing or drawing (NON-TASKS).

Examples:

A poem is written.
A letter is written.
A crossword puzzle is done.
A landscape is painted.
A novel is read.

MESSES AROUND WITH MATERIALS: Although the child manipulates USMES (or non-USMES) materials, the purpose of his behavior is not apparent.

Examples:

Blocks are piled.
Clay is pounded.
Buzzers are rung.
Etc.

INTERACTIONS

The child's predominant activity at the time of observation may be verbal interaction with another person or a group of people. The observer needs to discriminate between the following categories.

CHILD TO CHILDREN CATEGORIES:

TALK TO ANOTHER - TASK: The child talks with another child about the task.

TALK TO ANOTHER - SOCIAL: The child talks with another child socially.

TAKES PART IN SMALL GROUP DISCUSSION - TASK: The child talks in a group about the task.

TAKES PART IN SMALL GROUP DISCUSSION - SOCIAL: The child talks in a group about social, non-task topics.

CHILD TO TEACHER CATEGORIES:

GIVES PRE-STRUCTURED INFORMATION TO TEACHER: The child responds to the teacher according to a pre-structured format.

GIVES ORIGINAL INFORMATION TO TEACHER: The child talks with or to the teacher about the task.

SEEKS INFORMATION FROM TEACHER: The child seeks information from the teacher, questions the teacher.

TALKS TO TEACHER - SOCIAL: The child talks with the teacher socially.

TAKES PART IN CLASS DISCUSSION OR PRESENTATION: The child takes part in a class discussion or gives a presentation to the class.

LISTEN/LOOK:

LISTEN/LOOK - AT CHILD: The child attends to another child.

LISTEN/LOOK - AT SMALL GROUP: The child observes, looks on in a group setting.

LISTEN/LOOK - AT CLASS: The child observes, looks on during a total class activity.

LISTEN/LOOK - AT TEACHER/LECTURE/FILM: The child attends to a teacher, a lecture or a film.

OTHER:

COLLECTING MATERIALS/MAINTENANCE: Materials are collected or equipment is maintained.

Examples:
A pencil is sharpened.
Supplies for painting are gathered together.

RESTING/WAITING/FOOLING AROUND/ATTENDING TO SOMETHING OUTSIDE THE CLASS: The child is not actively involved in learning or free-time activities. The child is phased out or distracted.

Table 3

STUDENTS Observation Data from the 1973-74 USMES Evaluation

Observation Period	FALL		WINTER			SPRING	
Treatment Group	USMES Imp.	Control	USMES Dev.	USMES Imp.	Control	USMES Imp.	Control
Number of Classes	(10)	(10)	(14)	(7)	(6)	(5)	(3)
Category of Student Behavior	Percentages of Tallies in Each Category						
1. Measures	1.2	0.0	1.8	2.0	0.0	2.5	0.0
2. Counts	0.0	0.4	1.2	0.9	0.0	0.9	0.0
3. Constructs	7.9	0.4	11.6	0.0	0.0	2.8	0.0
4. Assembles	4.5	0.0	3.0	0.0	0.0	1.8	0.0
5. Tests/Experiments	18.4	0.8	1.3	2.1	5.7	4.0	0.0
6. Calculates	8.2	11.7	0.9	1.9	10.6	0.6	12.7
7. Records Data	6.2	1.8	1.1	6.5	0.2	2.3	0.0
8. Writes/Illustrates	0.2	0.2	5.6	2.5	4.1	3.9	0.0
9. Writes (pre-structured)	0.4	5.7	2.1	0.0	6.1	0.0	6.3
10. Reads How-To-Cards	0.2	0.0	0.8	0.0	0.0	0.1	0.0
11. Reads-Task	0.1	1.9	2.8	4.7	0.8	4.3	0.0
12. Free Reading, Writing, Drawing	0.5	0.9	3.4	2.2	1.2	1.2	0.6
13. Messes Around with Materials	1.1	1.2	1.3	0.1	0.9	1.4	0.0
14. Talks to Another-Task	2.2	1.0	2.8	3.2	3.5	4.6	3.9
15. Talks to Another-Social	3.8	4.7	1.5	3.2	7.2	4.1	8.0
16. Small Group-Task	2.3	0.3	12.4	0.0	1.4	1.4	0.0
17. Small Group-Social	1.1	1.9	0.1	0.0	0.0	0.0	0.0
18. Gives Pre-structured Info to Teacher	0.6	1.5	0.5	1.0	2.3	1.8	9.4
19. Gives Original Info to Teacher	3.3	0.8	1.3	2.2	1.7	6.1	0.0
20. Seeks Info from Teacher	2.9	3.5	2.0	1.7	2.7	2.6	3.2
21. Talks to Teacher, Social	0.2	0.4	0.3	2.3	0.0	0.1	0.0
22. Takes Part in Class Discussion, Presentation	4.9	11.2	6.7	17.1	4.4	8.7	10.7
23. Listen/Look at Child	7.3	1.9	4.8	13.2	4.2	2.7	2.3
24. Listen/Look at Small Group	1.4	7.2	1.2	2.1	1.2	0.3	0.0
25. Listen/Look at Class	2.3	2.6	7.2	3.2	0.4	0.5	1.9
26. Listen/Look at Teacher	14.1	31.0	13.2	21.0	30.1	28.4	26.3
27. Collecting Material/Maintenance	2.6	4.6	4.2	0.7	2.0	2.8	3.5
28. Resting/Waiting/Fooling Around	2.2	2.6	4.9	6.2	9.1	10.3	11.1
Total Percentages	100.1	100.2	100.0	100.0	99.8	100.2	99.9

Table 4

STUDENTS Observation Data from the 1974-75 USMES Evaluation

Observation Period	Beginning of Unit		Middle of Unit		End of Unit	
Treatment Group	USMES	Control	USMES	Control	USMES	Control
Number of Classes	(23)	(27)	(26)	(24)	(22)	(24)
Category of Student Behavior	Percentages of Tallies in Each Category					
1. Measures	1.6	0.1	1.6	0.0	1.9	0.2
2. Counts	0.1	1.1	0.5	0.1	0.3	0.4
3. Constructs/ ssembles	0.0	0.6	9.4	0.0	6.9	0.0
4. Graphs	2.2	1.0	1.1	0.0	0.9	0.0
5. Tests/ xperiments	2.3	0.6	2.7	1.5	1.0	2.5
6. Calculates	1.9	17.2	0.4	13.6	0.3	15.1
7. Records Data	.4	1.0	2.7	0.0	2.3	1.7
8. Writes composition/illustrates	0.2	2.9	7.4	2.2	0.5	0.9
9. Writes (prestructured)	2.7	11.7	2.5	10.6	5.2	9.2
10. Reads How-to-cards; plays tapes	0.3	0.0	0.0	0.0	0.0	0.0
11. Reads (prestructured)	2.7	6.0	1.1	13.4	3.1	5.8
12. Free Reading	0.7	1.1	1.5	1.0	1.4	0.1
13. Talks to another-task	6.6	3.4	5.7	3.7	5.7	3.7
14. Talks to another-social	4.4	5.2	3.1	3.4	4.6	3.6
15. Takes part in small group discussion-task	7.6	1.5	6.1	1.3	4.6	1.8
16. Takes part in small group discussion-social	1.8	0.6	0.8	1.4	2.2	1.6
17. Gives prestructured information to teacher	0.9	2.8	0.8	1.5	1.1	1.8
18. Gives original information to teacher	3.1	1.2	3.0	0.8	3.8	1.1
19. Seeks information from teacher	2.8	3.7	1.7	2.1	2.8	2.4
20. Talks to teacher-social	0.4	0.1	0.3	0.1	0.7	0.0
21. Takes part in class discussion or presentation	5.4	1.4	5.9	1.8	3.1	2.4
22. Listen/look at child	4.3	4.6	5.5	5.2	7.5	9.5
23. Listen/look at small group	2.5	0.9	1.8	0.7	1.7	1.0
24. Listen/look at class	1.8	0.3	4.1	1.3	1.9	3.2
25. Listen/look at teacher	19.4	16.5	17.7	20.4	20.1	19.4
26. Listen/look at film or AV materials	0.1	2.4	0.0	3.5	0.2	2.4
27. Collecting materials/maintenance	2.6	2.2	3.6	1.9	3.9	1.7
28. Resting/waiting	6.4	7.0	5.5	4.6	7.9	5.4
29. Fooling around	3.0	2.9	3.3	2.7	4.6	3.2
TOTAL PERCENTAGES	100.2	100.0	99.8	99.9	100.2	99.8